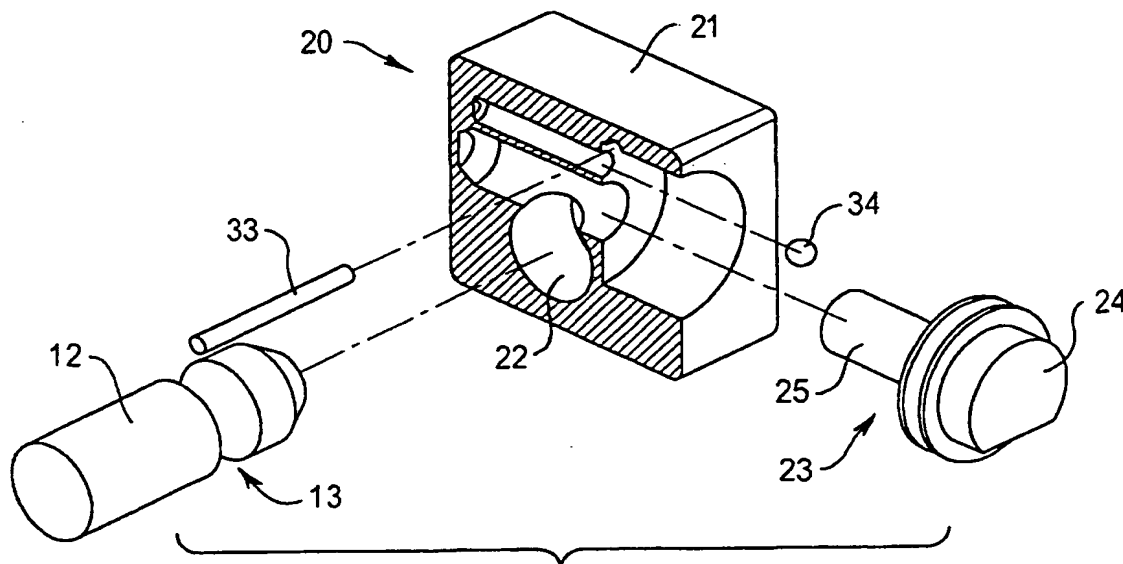




## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 7 : <b>F16B 21/18, E05B 65/00, 73/00, B60D 1/58, E04G 25/06</b>		<b>A1</b>	(11) International Publication Number: <b>WO 00/63564</b>
			(43) International Publication Date: 26 October 2000 (26.10.00)
(21) International Application Number: PCT/AU00/00310 (22) International Filing Date: 12 April 2000 (12.04.00) (30) Priority Data: PP 9759                      15 April 1999 (15.04.99)            AU PQ 3273                      6 October 1999 (06.10.99)            AU (71) Applicant (for all designated States except US): T-LOCK PTY. LTD. [AU/AU]; Suite 1, 657 Chapel Street, South Yarra, VIC 3141 (AU). (72) Inventor; and (75) Inventor/Applicant (for US only): VAN WISSEN, John, Anthony [AU/AU]; 13 Oban Court, Greenvale, VIC 3059 (AU). (74) Agent: PHILLIPS ORMONDE & FITZPATRICK; 367 Collins Street, Melbourne, VIC 3000 (AU).		(81) Designated States: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).  Published With international search report.	

(54) Title: LOCKING DEVICE FOR AN AXIALY MOVING PIN



## (57) Abstract

Locking device (20) includes housing (21) with bore (22) for receiving end portion (12) of a pin. With end portion (12) fully inserted in housing (21), body portion (25) of rotating locking member (23) can interact with circumferential recess (13) of end portion (12) to prevent longitudinal or axial movement of the pin relative to housing (21). When head portion (24) of member (23) is rotated through half a turn from the locking position, an indentation or notch in portion (25) is aligned with bore (22) and end portion (12) can be withdrawn from bore (22). Member (23) can be rotated by way of a key or other suitable tool. Locking device (20) can be used to secure the adjusting pin for telescopic members such as bracing used in building construction or a tow bar on a vehicle.

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## LOCKING DEVICE FOR AN AXIALY MOVING PIN

The present invention relates to a locking device and more particularly to a device for securing an adjusting pin or stud against removal.

5 The present invention has particular application as a safety device for securing in place the adjusting pins used in temporary bracing and it will be convenient to hereinafter describe the invention in this particular context. The present invention also has application for securing the ends of the temporary bracing to a base structure and erected precast concrete respectively and will also be  
10 described in this context. It will be appreciated, however, that the invention is not limited to these particular applications but that it is suitable for securement to a wide variety of pins or stud-like elements to prevent axial movement thereof. For example, the present application could be used as a safety device for a vehicle tow-bar. Such an application will also be described.

15

Temporary bracing is used in the building industry to hold precast concrete panels in the upright position during the construction of buildings from precast and prefabricated concrete sections. As panels of precast concrete are erected during the construction process, temporary bracing is used to hold the panels  
20 upright in their desired position until the panels are joined together to form a self-supporting structure. The temporary bracing typically includes telescopically adjustable bracing elements, the relative positions of which are fixed by an adjusting pin extending through aligned holes in the bracing elements. Typically, the temporary bracing is fully adjustable in increments of  
25 around 300mm. Once the brace is in the correct position and secured to the base structure and erected precast concrete, the adjusting pin is inserted and is fixed against removal using a split pin, 'R' clip or lock wire to keep the adjusting pin in place.

30 Unfortunately, the procedure of using split pins, 'R' clips or lock wiring to secure the adjusting pin is unsatisfactory and dangerous. Unauthorised persons and/or vandals who gain access to the construction site can relatively easily cut, untwist or otherwise remove the split pin or wire lock, thereby allowing

removal of the adjusting pin from the brace. Similar unauthorised loosening or removal of the attaching means, provided at either end of the bracing, for securing the bracing to the erected precast concrete and base structure, may also occur. This creates the potential for disaster on the building site with  
5 precast concrete panels weighing up to 15 tonnes being unrestrained and able to topple over. Accordingly there is not only an enormous potential for damage to property with resultant time delays and costly rework but also a tremendous risk to the health and safety of people on the site.

10 There is therefore a clear need for a relatively tamper resistant safety locking device for securing the adjustment pin on temporary bracing. There is also a clear need for a relatively tamper resistant safety locking device for securing the bracing to both the base structure and erected precast concrete.

15 According to one aspect of the present invention there is provided a device for securing a pin or elongate stud against movement in a longitudinal or axial direction. The device includes a housing having a bore for receiving an end portion of the pin and a locking member within the housing for engagement with the end portion to fasten the housing on the pin preventing longitudinal or axial  
20 movement of the pin relative to the housing.

In this way, if the pin is inserted through an aperture in an adjustable brace, the device of the present invention can be used to prevent removal of the pin. With the size of the housing being substantially larger than the aperture through the  
25 brace, fastening the device to the pin thereby secures the adjusting pin against being axially withdrawn through the aperture.

According to another aspect of the present invention there is provided a device for securing a fastener against movement in a longitudinal or axial direction  
30 along a pin or elongate stud. The device includes a housing having a bore for receiving an end portion of the pin and a locking member within the housing for engagement with the end portion to fasten the housing on the pin thereby preventing removal of the fastener from the pin.

In this way, if the temporary bracing is secured between a base structure and erected precast concrete via pin and fastener arrangements in which pins are attached to and extend from the base structure and erected precast concrete, the device of the present invention can prevent removal of the fasteners from the pin such that unauthorised disconnection of the bracing footing from the base structure and erected precast concrete is not possible.

In one form of the invention the securing device secures to the end of a threaded pin. In this way, a threaded fastener attached to the pin is prevented from being removed from the pin by the security device. This is because the threaded aperture in the fastener is smaller in size than the securing device, meaning that the fastener is prevented from being removed from the pin by the securing device.

When attached to and extending from a base structure or erected precast concrete, the pin is preferably in the form of an anchor pin or rock pin. In this form, the pin includes an anchoring means to prevent unauthorised removal of the pin from the base structure or erected precast concrete. The anchoring means could include a flange portion which is set into the base structure or erected precast concrete. Alternatively, the anchoring means could include a sleeve or other expanding section which is placed into a bore provided in the base structure or erected precast concrete, and which expands radially within the bore upon insertion of the pin into the sleeve. Other anchoring means to secure the pin to the base structure or erected precast concrete to prevent unauthorised removal of the pin are also envisaged.

In one form of the invention the locking member is moveable within the housing between an engaging position and a disengaged position.

In one form of the invention the end portion of the pin includes a recess for interaction with the locking member in the engaging position.

In one form of the invention the locking member is biased to the engaging position. In the engaging position the locking member preferably extends into the recess in the end portion of the pin to prevent longitudinal or axial movement of the pin relative to the housing.

5

The recess in the end portion of the pin could be in the form of a notch, slot or groove, which extends continuously around the periphery of the pin such that the angular orientation of the pin with respect to its longitudinal axis is of no relevance to whether or not the locking member will be in alignment with the  
10 recess when the end portion of the pin is inserted within the bore of the housing. The recess could take any practical form. It could be curved in profile or instead could take the form of a straight sided or straight cut recess.

In one form of the invention the locking member extends substantially  
15 transverse to the pin-receiving bore and is rotatable between the engaging position at which it intersects with the bore and the disengaged position at which it has no intersection with the bore. The transversely oriented locking member is located to align with the recess provided at the end portion of the pin when the pin is received in the housing bore. The locking member includes  
20 a notch or indentation which, in the disengaged position, is adjacent the bore so as to not obstruct or intersect with bore thereby allowing the pin to be freely inserted into or withdrawn from the locking device housing. When the locking member is rotated to the engaging position the notch or indentation is rolled out of alignment with the bore and the body of the locking member rotates into the  
25 recess in the pin thereby preventing relative axial movement between the housing and the pin.

In one form of the invention the locking member is rotatably actuatable from the outside of the housing by means of an appropriately configured tool or key. The  
30 rotatable locking member preferably has an exposed external end which is adapted for operation by a complementary configured tool or key member. Preferably the locking member has a head portion located counter-sunk in a recess at a side of the housing to minimise or inhibit unauthorised operation.

In one form of the invention the bore in the housing is a substantially smooth-sided bore having a cross-sectional geometry complementary to and only slightly larger than the cross-sectional geometry of the pin so that the pin may be received in a relatively close sliding fit.

5

In at least one form of the invention the device includes a mechanism for retaining the locking member in the disengaged position against a bias tending to return it to the engaging position. The device may also include means of releasing that retaining mechanism to allow automatic return of the locking member to the engaging position.

10

In one form of the invention the bore in the housing is a blind bore having a depth such that the recess in the pin is in alignment with the locking member when the pin is inserted to the full depth of the bore.

15

In at least one form of the invention the housing is of robust construction and may be machined from solid metal such as zinc, steel, brass, aluminium or the like. The housing is preferably cast, but could instead be fabricated as a powdered metal (p/m) moulding.

20

The description provided above is generally directed to a locking device as used in temporary bracing. However, another application envisaged is as a locking device to prevent unauthorised removal of a vehicle tow ball. A pin of the type previously described could be inserted through apertures provided in the tow bar support which is permanently attached to the vehicle, as well as through the detachable shaft which is generally sized so as to be slidably received within the tow bar support, and upon which the tow ball is mounted. When the pin is so inserted, a securing device can then be attached to the end of the pin to thereby prevent removal of the detachable shaft and ball from the tow bar support.

25

30

For assistance in arriving at an understanding of the present invention examples of the device of this invention are illustrated in the accompanying

drawings. The preceding description of the locking device may be read with reference to those drawings. However, as the drawings illustrate examples only their particularity is not to be understood as superseding the generality of the preceding description. In the drawings:

5

Fig. 1 is a side view of temporary bracing supporting a pre-cast concrete panel with the adjusting pin of the bracing incorporating a locking device according to one form of the present invention; Fig. 1 also shows a locking device of the invention used in a different application at the foot of the bracing.

10

Fig 1a is an enlarged view of the pin and locking device illustrated in Fig. 1.

Fig 1b is an enlarged view of the locking device used at the foot of the bracing illustrated in Fig 1.

15

Fig. 2 is an exploded perspective view of a locking device according to one form of the present invention with the housing shown in section through a central plane;

20 Fig. 3 is a perspective view of the housing of the locking device of Figure 2 shown fully sectioned through a central plane thereof;

Fig. 4 is a side view of the locking member of the device shown in Fig. 2;

25 Fig. 5 is a side view of the device showing the end portion of the locking pin received within the housing with the locking member in the disengaged position;

Fig. 6 is an end view of the device shown in Fig. 5; and

30

Fig. 7 is an exploded and partially sectioned perspective view of a locking device according to another form of the invention.



Fig. 8 is a perspective view of a pin or stud, according to another embodiment of the invention, with a fastener attached.

Fig. 9 is a perspective view of the pin/stud and fastener of Figure 8 when  
5 fastened to a footing of the temporary bracing and including a securing device.

Fig. 10 is a perspective view of the pin/stud and fastener of Figure 8 when fastened to a plate.

10 Figure 11 is a perspective view of a pin according to another embodiment of the invention used to secure a vehicle tow bar ball. The drawing also illustrates a securing device.

Fig. 12 is an assembled version of the locking device of Fig. 7, when attached  
15 to a pin.

Fig. 13 is a perspective view of a locking device according to another form of the invention, when secured to a pin.

20 Referring to Fig. 1, temporary bracing is schematically shown supporting an upright concrete panel during construction of a building. The bracing includes a pair of telescopically adjustable brace elements, the relative positions of which can be fixed with an adjusting pin 10 inserted through aligned adjustment holes in the brace elements. One end portion 11 of the adjusting pin 10 is bent out of  
25 alignment with the longitudinal axis of the pin to provide a stop or limit to the extent to which the pin can be inserted through the adjustment holes. As is more fully described below, the other end portion 12 is secured within a locking device 20 formed in accordance with the present invention.

30 Referring now to Figs. 2 to 6, the device 20 for securing the adjusting pin 10 against unauthorised withdrawal from the adjustment holes of the temporary bracing includes a robust metal housing 21 having a bore 22 for receiving the end portion 12 of the pin 10. The bore 22 is a smooth-sided blind bore and has

a diameter only slightly larger than the diameter of the pin 10 in order to slidably receive the pin in a relatively close fit.

The securing device 20 further includes a rotatable locking member 23 which extends substantially transverse to the pin-receiving bore 22. The locking member 23 includes a head portion 24 and an elongate body portion 25 and is retained within a cavity 26 formed in the housing 21. The locking member 23 is rotatable between a disengaged position at which the bore is unobstructed allowing the pin 10 to be freely inserted into or withdrawn from the housing 21, and an engaging position at which the body portion 25 of the locking member interacts with the end portion 12 of the pin to prevent longitudinal or axial movement of the pin relative to the housing 21.

The end portion 12 of the adjusting pin 10 includes a recess 13 in the form of a notch or groove which extends continuously around the periphery of the pin. When the end portion 12 is fully inserted into the bore 22 of the housing, the notch 13 is in substantial alignment with the transversely extending body portion 25 of the locking member. As can be seen in Fig. 4, the body portion includes an indentation 27 which is located adjacent the bore 22 when the locking member is in the disengaged position. That is, when the indentation or notch 27 is aligned with the bore 22 the bore remains unobstructed to facilitate insertion and/or withdrawal of the end portion 12 into and/or out of the housing 21. With the end portion of the pin fully inserted into the housing, the locking member 23 can be rotated, for example through 180°, to the engaging position at which the side of the body portion 25 opposite the indentation 27 extends into the recess 13 in the end portion of the pin thereby securing the device 20.

It will be appreciated that the rotatable locking member 23 essentially functions as an eccentric locking cam. Accordingly, the body portion 25 of the locking member could simply be constituted by an eccentric rod which extends from the head portion 24 and is rotatable between the disengaged and engaging positions with the recess 13. It will also be appreciated that the extent of angular rotation of the locking member 23 between the engaging and disengaged positions need not be 180°, but may be at any of a broad range of

designed angles. For example, it may be desirable to effect engagement and disengagement of the adjusting pin within only 90° angular rotation of the locking member.

5 The actual assembly of the securing device 20 in the example shown will now be described with reference to Figs. 2 to 6. The head portion 24 of the locking member 23 includes a flange 29 which seats against a shoulder 30 in the cavity 26. The flange 29 has a semi-circular groove 31 formed around the periphery thereof. When the device 20 is assembled the locking member 23 is located in  
10 the cavity 26 with the groove 31 aligned with a passage 32 formed in the housing. Upon assembly, a plain smooth-sided roll pin 33 is fully and irreversibly inserted in a snug sliding fit into the passage 32 from a side of the housing 21. As the pin 33 is inserted from the side of the housing which, in use, is positioned next to the brace, it is inaccessible to vandals. The roll pin 33  
15 partially resides in the semi-circular groove 31 to retain the locking member 23 in the cavity 26 while allowing the locking member to rotate between the engaging and disengaged positions. A spring, e.g. a torsional spring, (not shown) may also be provided to maintain a rotational bias on the locking member towards the engaging position.

20

The locking member 23 is non-removably mounted in the housing, while a spring (not shown) and a ball bearing 34 are also held captive within a passage 35. The spring biases the ball 34 into contact with the underside of the locking member flange 29. The underside of the flange includes detents 36  
25 to positively engage with the ball bearing 34 in each of the engaging and disengaged positions. In this way, the operator can recognise each of the engaging and disengaged positions by feel and by a 'click' sound when the locking member is rotated.

30 In operation, an appropriately configured tool or key (not shown) is inserted into the end opening of the cavity 26 to operatively engage the head portion 24 of the locking member which is countersunk in the side of the housing 21. In the example given, the tool would have a partially cylindrical configuration with a

flat side to complement the geometry of the head portion 24. It will be appreciated, however, that various complementary male/female mating geometries would be suitable for the head portion and tool/key. The tool/key is also desirably configured with a handle grip to facilitate rotation of the locking member 23 between the engaging and disengaged positions.

Referring now to Fig. 7 of the drawings, an alternative form of the invention is shown. In this case the locking device 20 does not include the ball 34 and detents 36. Rather, this device has a button-actuated locking member 23. The locking member is permanently biased to the engaging position by a spring means (not shown) which resides in the cavity 37 and acts against a lug 38 depending from the underside of the locking member flange 29. The rotational displacement of the locking member between the engaging and disengaged positions is 90° (i.e. a quarter-turn).

A push-button mechanism 39 is provided for automatic actuation of the device 20. The mechanism 39 includes a button member 40 having a shaft 41 which is received in the passage 42 against a spring bias. The button member 40 also has a ramped pawl 43 for engagement with a recess (not shown) in an underside of the flange 29 of the locking member head portion 24. The pawl 43 engages that recess in the flange 29 under the influence of the spring in the passage 40 when the locking member 23 is rotated with the appropriate tool to the disengaged position. The pawl 43 is thereby able to hold locking member in the disengaged (i.e. open) position against the force of the spring means biasing the locking member (via lug 38) back to the engaging position.

The button member 40 includes a crescent-sectioned actuatable portion 44 which sits in its own semi-cylindrical slot 45 adjacent a periphery of the locking member head portion 24. When the pawl 43 holds the locking member in the disengaged position, the top of the button member sits in the slot 45 just below the outer surface of the housing 21. Pushing the button member 40 inwardly releases the pawl 43 from the recess and allows the locking member 23 to rotate automatically under its spring bias to the engaging position.

With reference to Fig. 1, the locking device 20 of the invention may also be used at the foot of the temporary bracing to prevent the footing from being released from the base structure. An upstanding stud from the footing may receive and engage with the locking device 20 in the manner described such that the device 20 is positioned over the top of the bolt(s) attaching the footing to the base. In this way upward movement of the bolt(s) is obscured thereby preventing them from being unscrewed. This may further enhance the security of bracing arrangement.

Figure 8 illustrates a stud or pin 10 which is designed to be integrated or otherwise securely attached to a base structure or erected pre-cast concrete. Such a stud or pin is envisaged for use in conjunction with temporary bracing (not shown) for the erection of concrete slabs on building sites. The stud includes a securing portion 51 which can be integrated into or otherwise securely attached to a base structure or erected pre-cast concrete (not shown). A threaded portion 52 is provided enabling a screw threaded fastener 53 to be attached to the stud 10. As previously described, an end portion 12 and a notch 13 are provided on the stud 10, thereby enabling a securing device (not illustrated) to be attached to the stud 10. It is to be appreciated that the diameter of the threaded portion 52 is larger than the diameter of the end portion 12. This allows the fastener 53 to be attached to and removed from the pin 10, over the end portion 12, as desired. The fastener 53 is in the form of a nut.

Figure 9 illustrates the pin 10 of Figure 8 when used with a securing device 20 to prevent unauthorised loosening of the fastener 53 threadably attached to the pin 10. In the arrangement illustrated the fastener 53 tightens the footing 54 of a temporary bracing against the base structure (not shown) and, once this is achieved, the securing device 20 is attached to the pin 10 to prevent unauthorised loosening of the fastener 53.

Figure 10 is similar to Figure 9, except that a plate 55 is securely attached between the brace structure (not shown) (into which securing portion 51 extends) and fastener 53.

- 5 In each of Figures 7 to 10 securing portion 51 includes an anchoring means to prevent unauthorised removal of the pin 10 from the base structure or erected pre-cast concrete. In these embodiments the securing portion 51 is radially flanged (this has not been illustrated). The flange could take any practical form.
- 10 Figure 11 illustrates a pin 10 and securing device 20 of the same form as previously described and illustrated, when used to prevent unauthorised removal of a vehicle tow-bar ball 56. The pin 10 extends through holes 57 provided in the tow-bar support 58, which is securely attached to a vehicle (not shown); and a detachable shaft 59, upon which the ball 56 is mounted. The pin
- 15 10 is secured in place by a securing device 20. When securing device 20 is attached, the pin 10 cannot be removed from the holes 57, thereby preventing unauthorised removal of the detachable shaft 59 and ball 56.

- Figure 12 illustrates an assembled version of the locking device 20 of Figure 7
- 20 when secured to adjusting pin 10. The device 20 includes a rotatable locking member 23. The device 20 includes a head portion 24 and a push button 60. The push button 60 is provided such that, when depressed, it locks the device 20 to pin 10. To remove the device 20 from the pin 10, the head portion 24 is rotated by either a tool or key which operatively engages the head portion 24.
- 25 Various complimentary male/female mating geometries would be suitable for the head portion and tool/key.

- Finally, Figure 13 illustrates a further form of locking device 20 when secured to adjusting pin 10. This embodiment is similar to that illustrated in Figure 12,
- 30 except that the device 20 does not include a push button 60 (see Figure 12). Instead, the device 20 includes a key operated barrel 61 which, when operated by a key K, is able to both lock and unlock the device 20 to the pin 10.

The securing device 20 of the present invention thus provides a simple and effective means of addressing the dangerous conditions brought about by the absence of satisfactory securing of temporary bracing on building sites; as well as for applications such as the securing of vehicle tow bar balls. Its robust  
5 construction makes it durable and highly resistant to tampering and/or attempts to remove it by force. The fact that the end portion of the adjusting pin may be completely enclosed by the housing prevents the pin from being driven out by a heavy blow. In addition, the arrangement of the locking member head counter-sunk into the housing further inhibits tampering and also increases resistance  
10 to fouling by ingress by dirt and grit. Importantly, the construction of the device makes ease of operation a further major benefit.

It is to be understood that various alterations, modifications and/or additions may be introduced into the construction and arrangement of the part herein  
15 described without departing from the spirit or ambit of the present invention.

It is also to be understood that reference to "pin" within the claims encompasses pins, elongate studs, and similar objects to which the securing device defined in the claims might be secured.

20

**CLAIMS:**

1. A device for securing a pin against movement in a longitudinal or axial direction, the device including:

a housing having a bore for receiving an end portion of the pin, and

5 a locking member within the housing for engagement with the end portion to fasten the housing on the pin, preventing longitudinal or axial movement of the pin relative to the housing.

2. A device for preventing removal of a fastener from around a pin, the device including:

a housing having a bore for receiving an end portion of the pin, and

a locking member within the housing for engagement with the end portion to fasten the housing on the pin,

15 the device thereby creating a barrier against axial removal of the fastener from around the pin via the end portion.

3. A device according to claim 1 or claim 2, wherein the locking member is rotatable between an engaging position at which it intersects with the bore and a disengaged position at which it has no intersection with the bore.

20

4. A device according to any one of the preceding claims, wherein the locking member includes a head portion and an elongate body portion.

5. A device according to claim 4, wherein the head portion includes a flange which seats against a shoulder within a cavity formed in the housing.

25

6. A device according to claim 5, wherein the flange includes a groove around the periphery thereof, the groove being provided to partially house a retaining pin to retain the locking member in the cavity while allowing the locking member to rotate between the engaging and disengaged positions.

30



7. A device according to any one of claims 4 to 6, wherein the elongate body portion of the locking member extends substantially transverse to the pin-receiving bore.

5 8. A device according to any one of claims 3 to 7, wherein the locking member is biased towards the engaging position.

9. A device according to claim 8, including a mechanism for retaining the locking member in the disengaged position against the bias tending to return it  
10 to the engaging position.

10. A device according to claim 9, including a means of releasing the retaining mechanism to allow automatic return of the locking member to the engaging position.

15

11. A device according to any one of claims 3 to 10 wherein, when in the engaging position, the locking member extends into a recess in the end portion of the pin to prevent longitudinal or axial movement of the pin relative to the housing.

20

12. A device according to any one of claims 3 to 11, wherein the locking member includes a notch or indentation which, in the disengaged position, is adjacent the bore so as to not obstruct or intersect with bore thereby allowing the pin to be freely inserted into or withdrawn from the locking device housing.

25

13. A device according to claim 12, wherein when the locking member is rotated to the engaging position, the notch or indentation is rolled out of alignment with the bore and the body of the locking member rotates into the pin recess thereby preventing relative axial movement between the housing and  
30 the pin.

14. A device according to any one of claims 3 to 13, wherein the locking member is rotatably actuatable from the outside of the housing by means of an appropriately configured tool or key.

5 15. A device according to any one of claims 3 to 14, wherein the device includes a button-actuated locking member for automatic actuation of the device.

10 16. A device according to any one of claims 11 to 15, wherein the bore in the housing is a blind bore having a depth such that the recess in the pin is in alignment with the locking member when the pin is inserted to the full depth of the bore.

15 17. A device according to any one of the preceding claims when used to prevent unauthorised removal of temporary bracing.

18. A device according to any one of claims 1 to 16, when used to prevent unauthorised removal of a vehicle tow ball.

20 19. A device according to claim 18, wherein the pin is inserted through apertures provided in a tow bar support which is permanently attached to the vehicle, and through a detachable shaft which is dimensioned so as to be slidably received within the tow bar support, and upon which the tow ball is mounted, allowing the device to then be attached to the end of the pin to  
25 thereby prevent removal of the detachable shaft and ball from the tow bar support.

20. A pin for use with a device according to any one of the preceding claims,

30 21. A pin for use with a device according to claim 20, wherein the pin includes a threaded shaft for attachment of a threaded fastener.

22. A pin for use with a device according to claim 20 or claim 21, wherein the pin includes an anchoring means to prevent unauthorised removal of the pin from a base structure, precast concrete or the like.

5 23. A pin for use with a device according to any one of claims 20 to 22, wherein the pin includes a recess for interaction with the locking member in the engaging position, and wherein the recess extends continuously around the periphery of the pin such that the angular orientation of the pin with respect to its longitudinal axis is of no relevance to whether or not the locking member will  
10 be in alignment with the recess when the end portion of the pin is inserted within the bore of the housing.

24. A device according to any one of claims 1 to 19 in combination with a pin according to any one of claims 20 to 23.

15

25. A device according to any one of the embodiments substantially as herein described and illustrated with reference to the accompanying drawings.

26. A pin for use with a device according to any one of the embodiments  
20 substantially as herein described and illustrated with reference to the accompanying drawings.

27. A device and pin combination according to any one of the embodiments  
25 substantially as herein described and illustrated with reference to the accompanying drawings.

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FIG 1

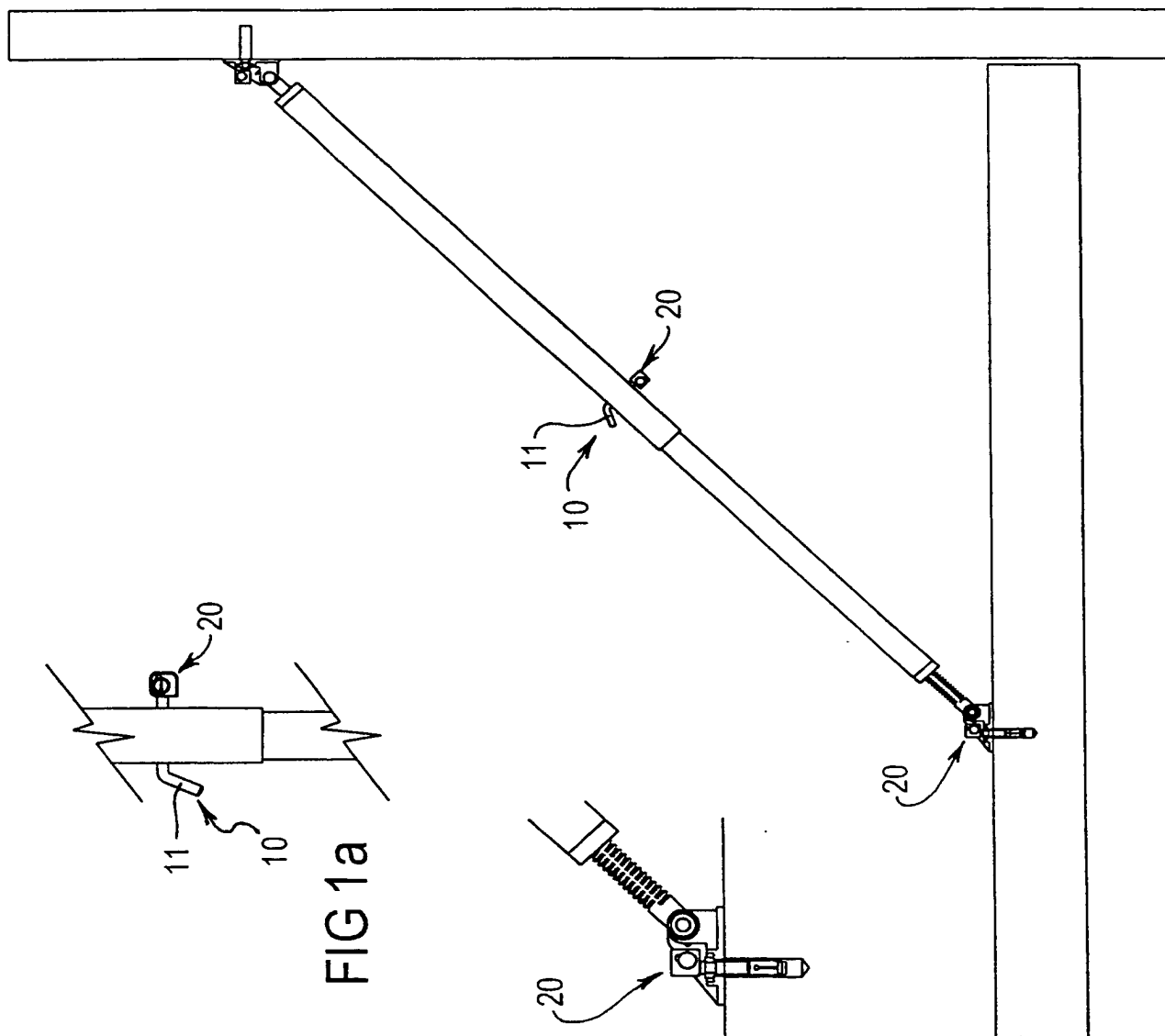


FIG 1a

FIG 1b

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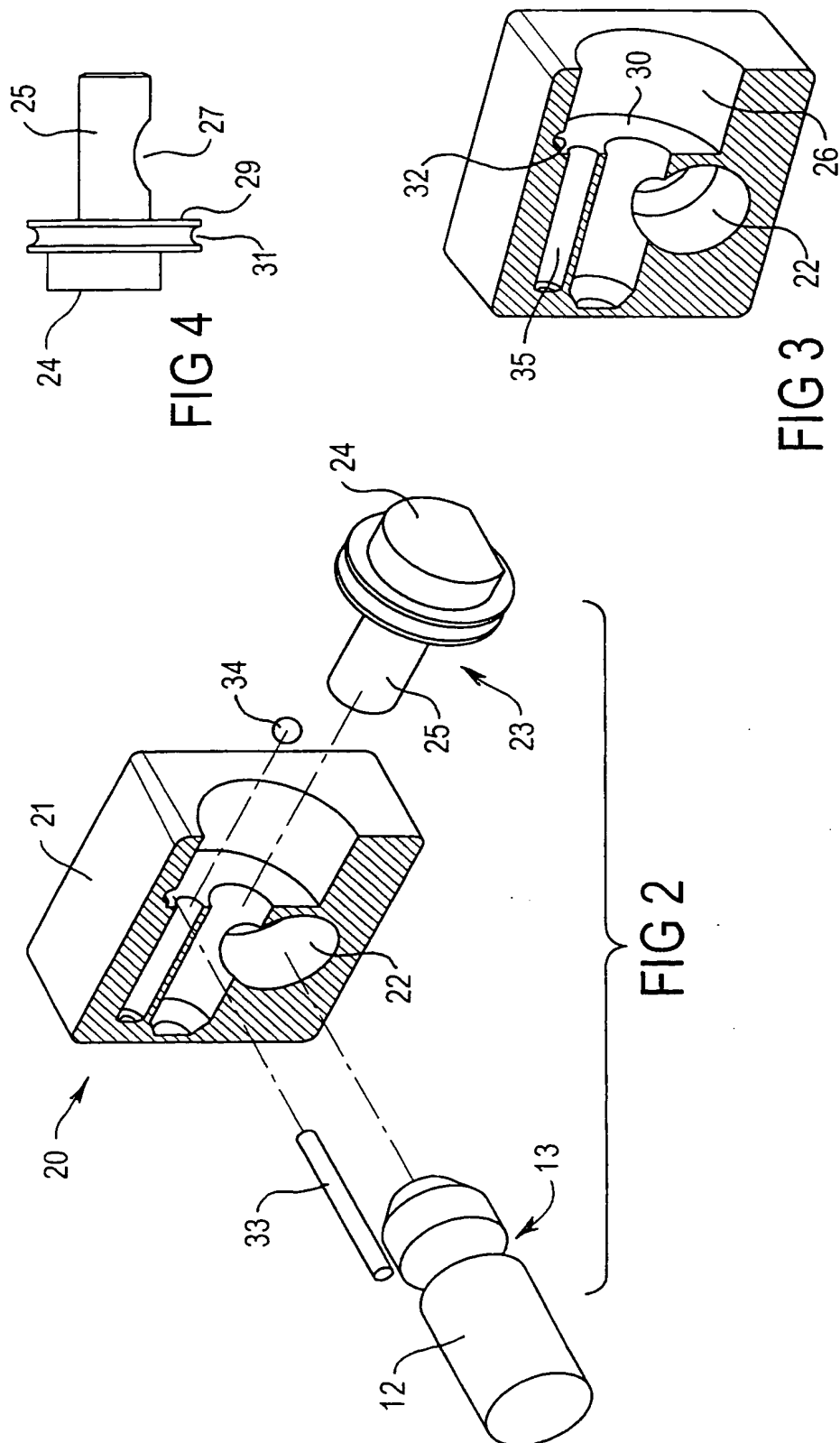


FIG 5

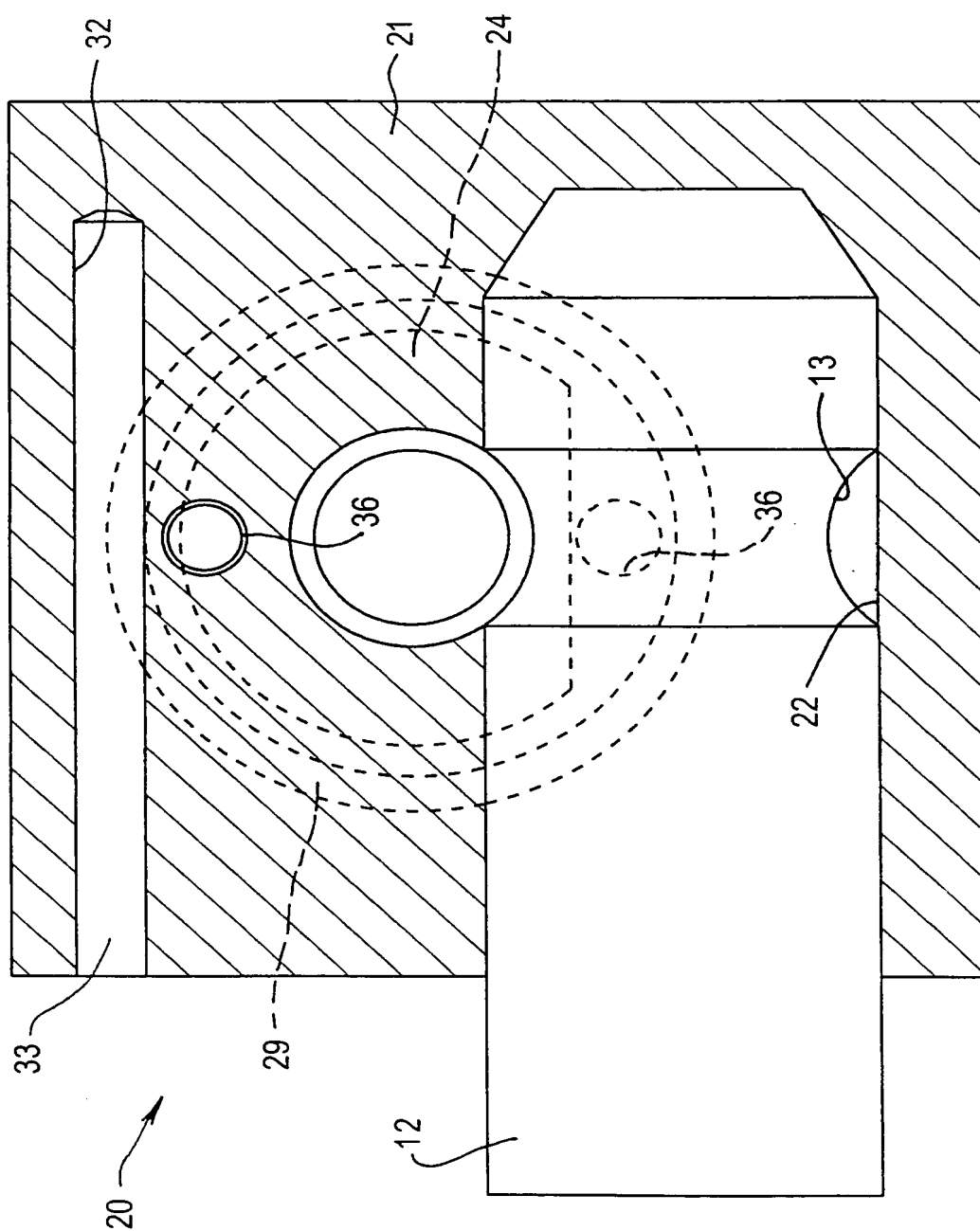
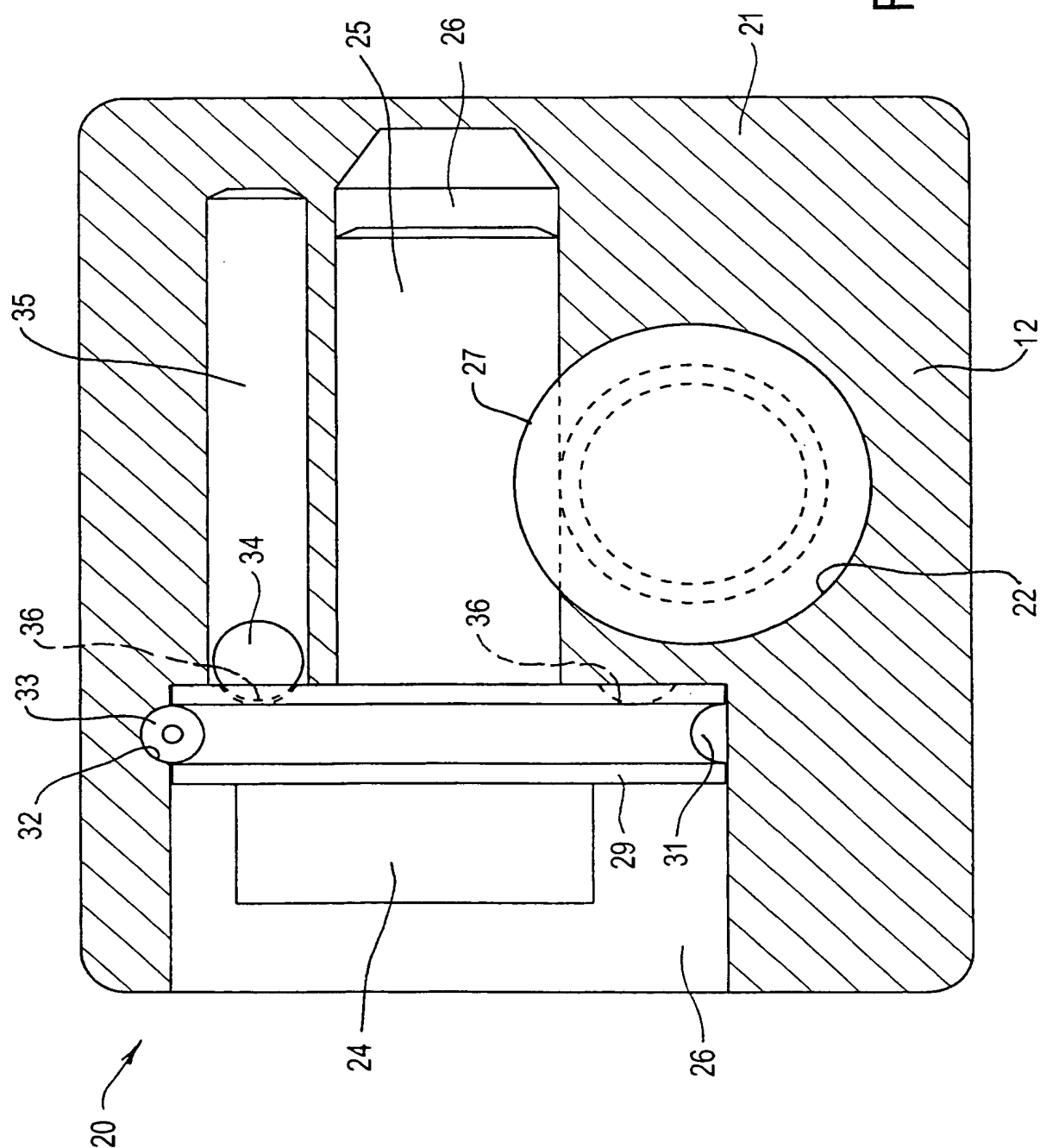


FIG 6



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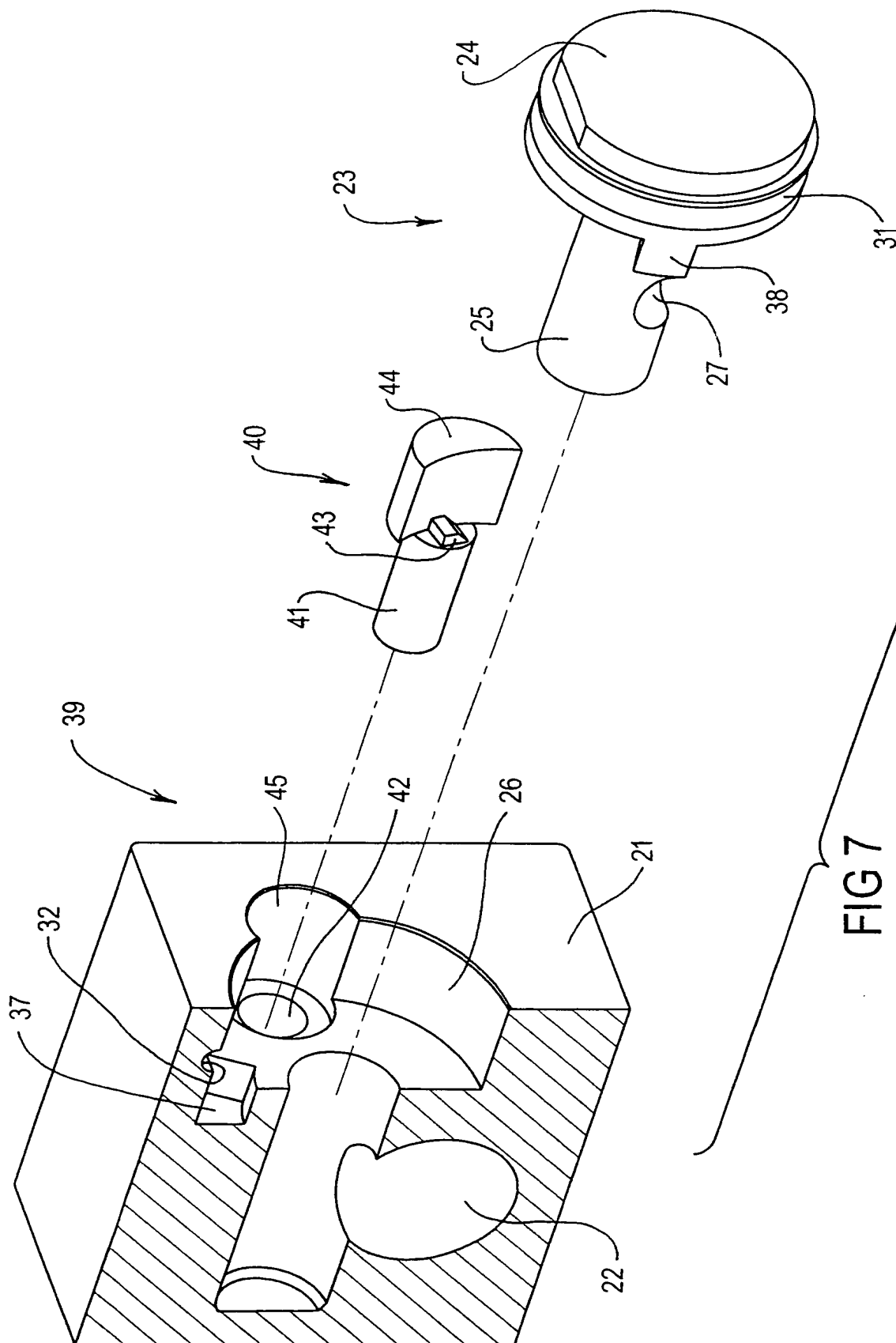


FIG 7



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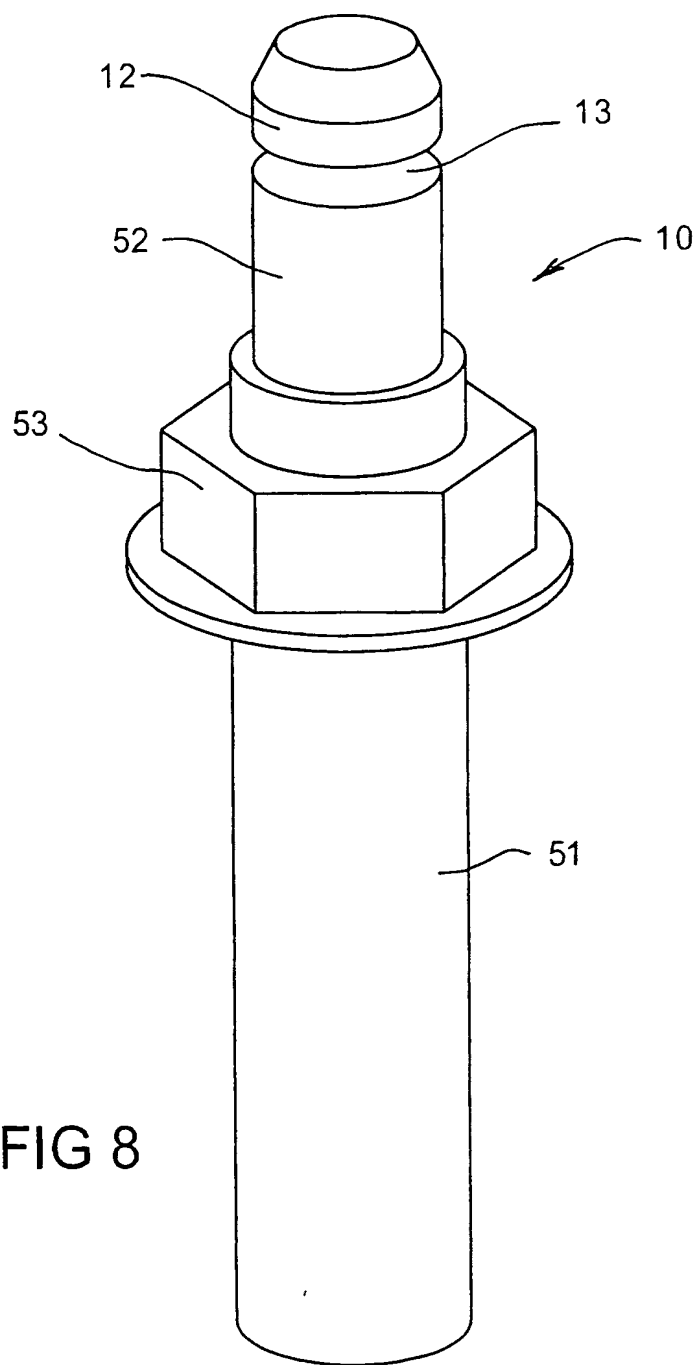
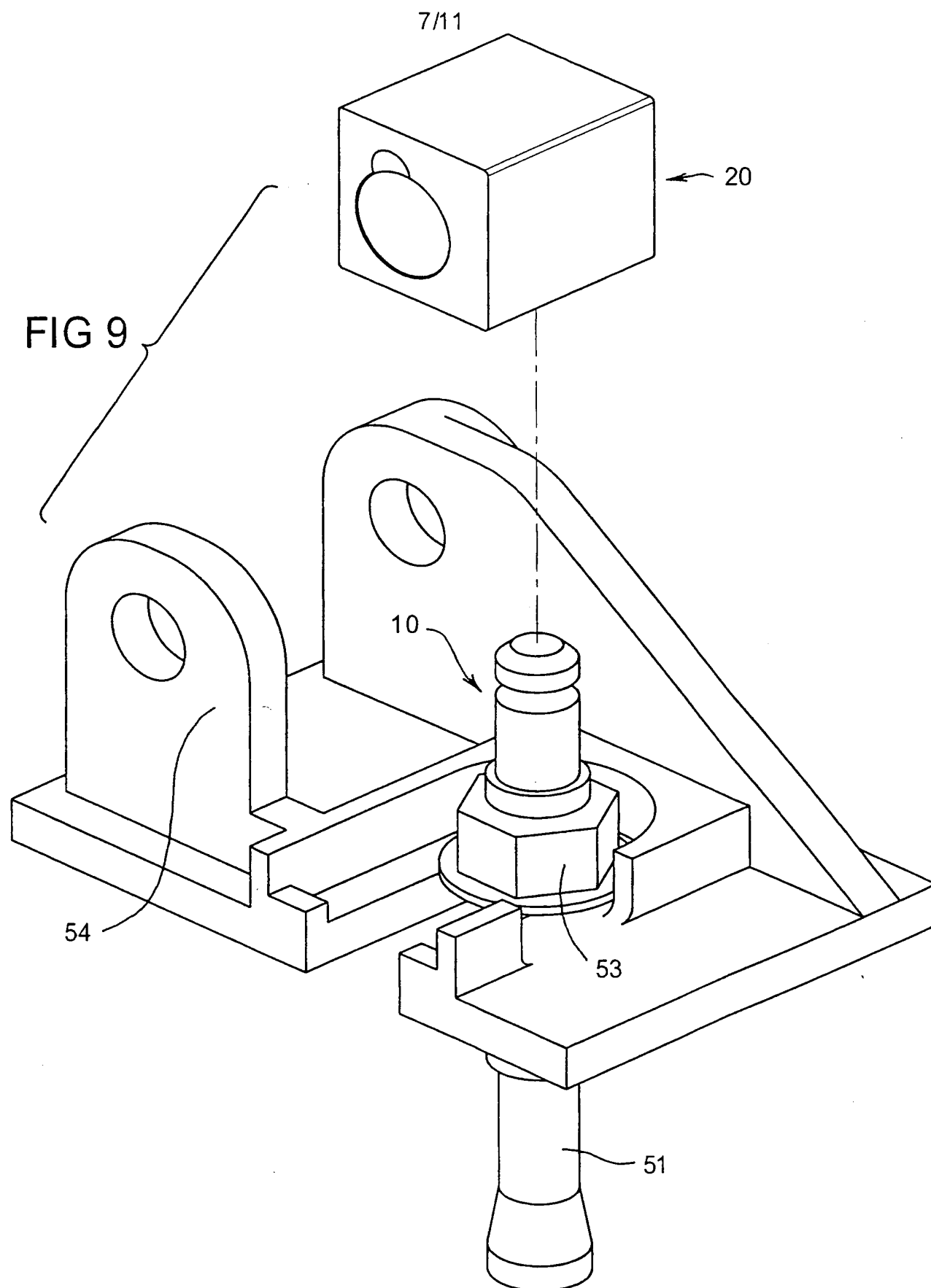
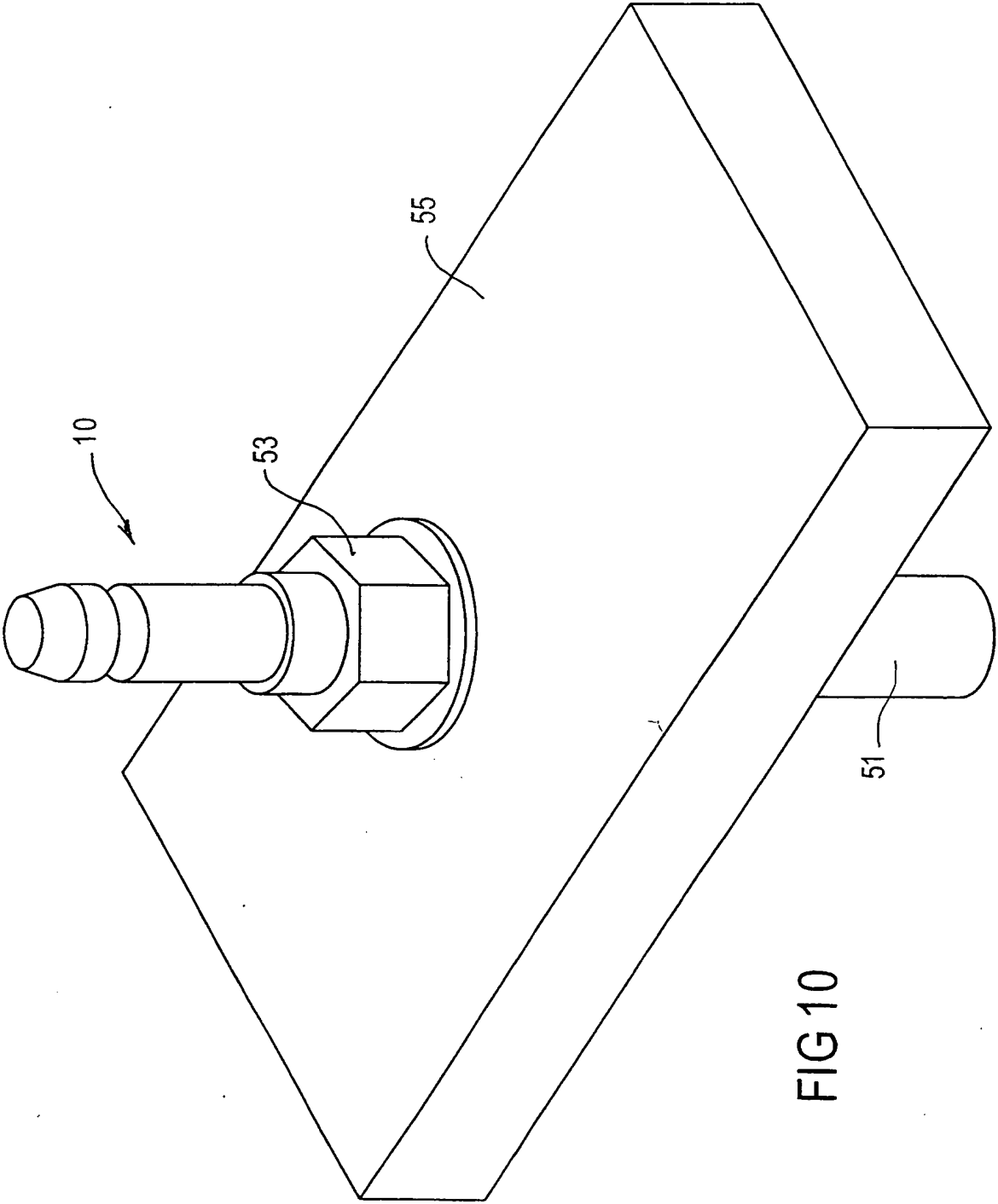
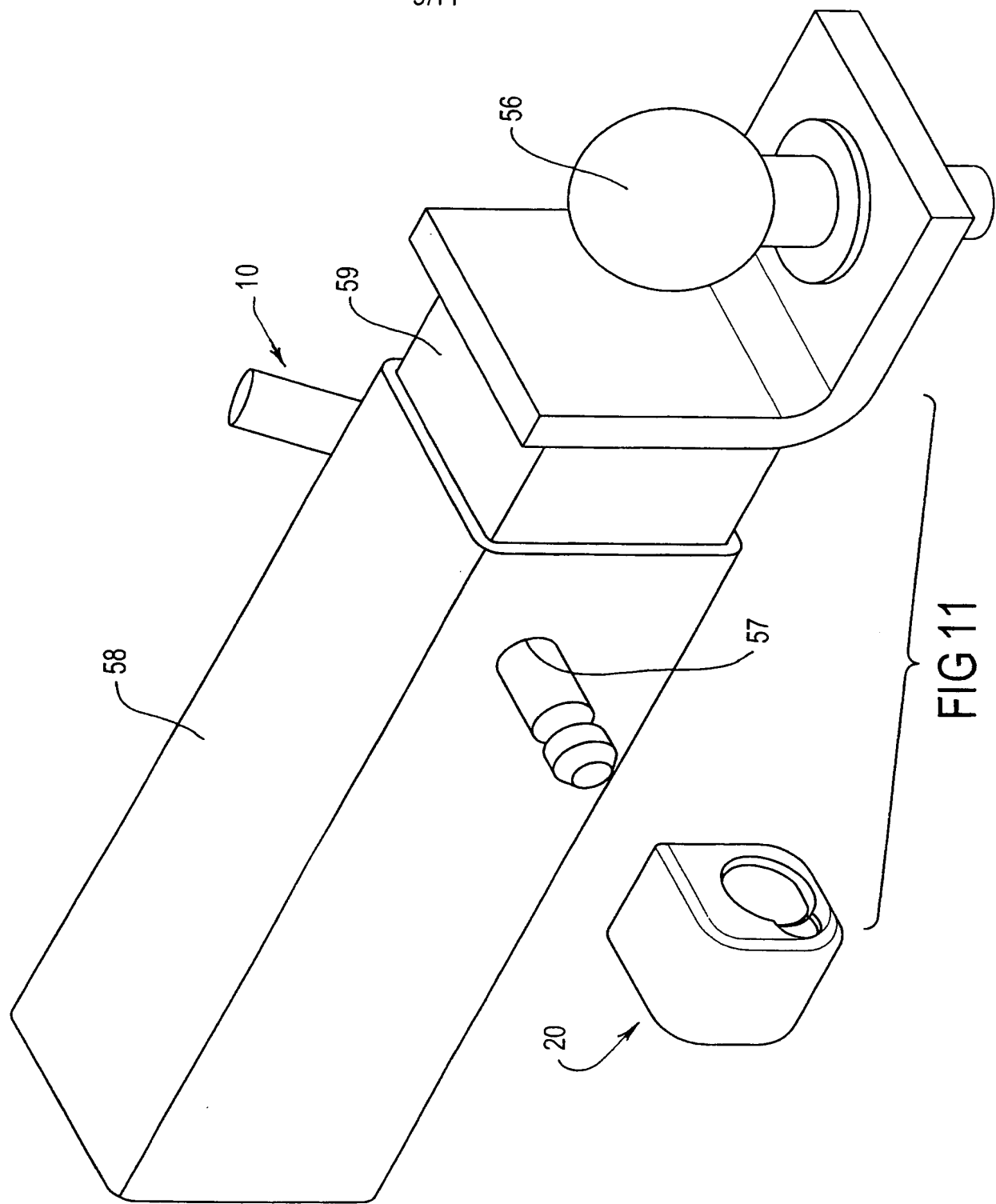


FIG 8

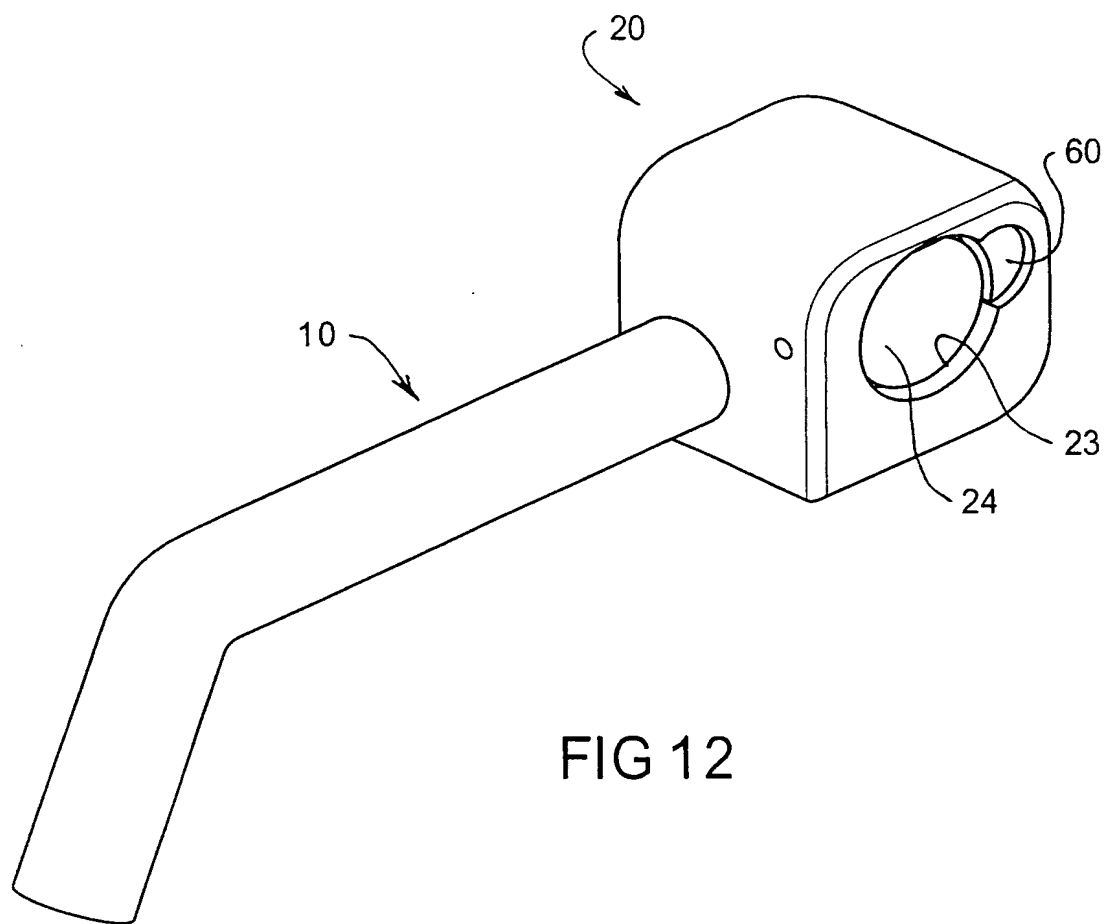




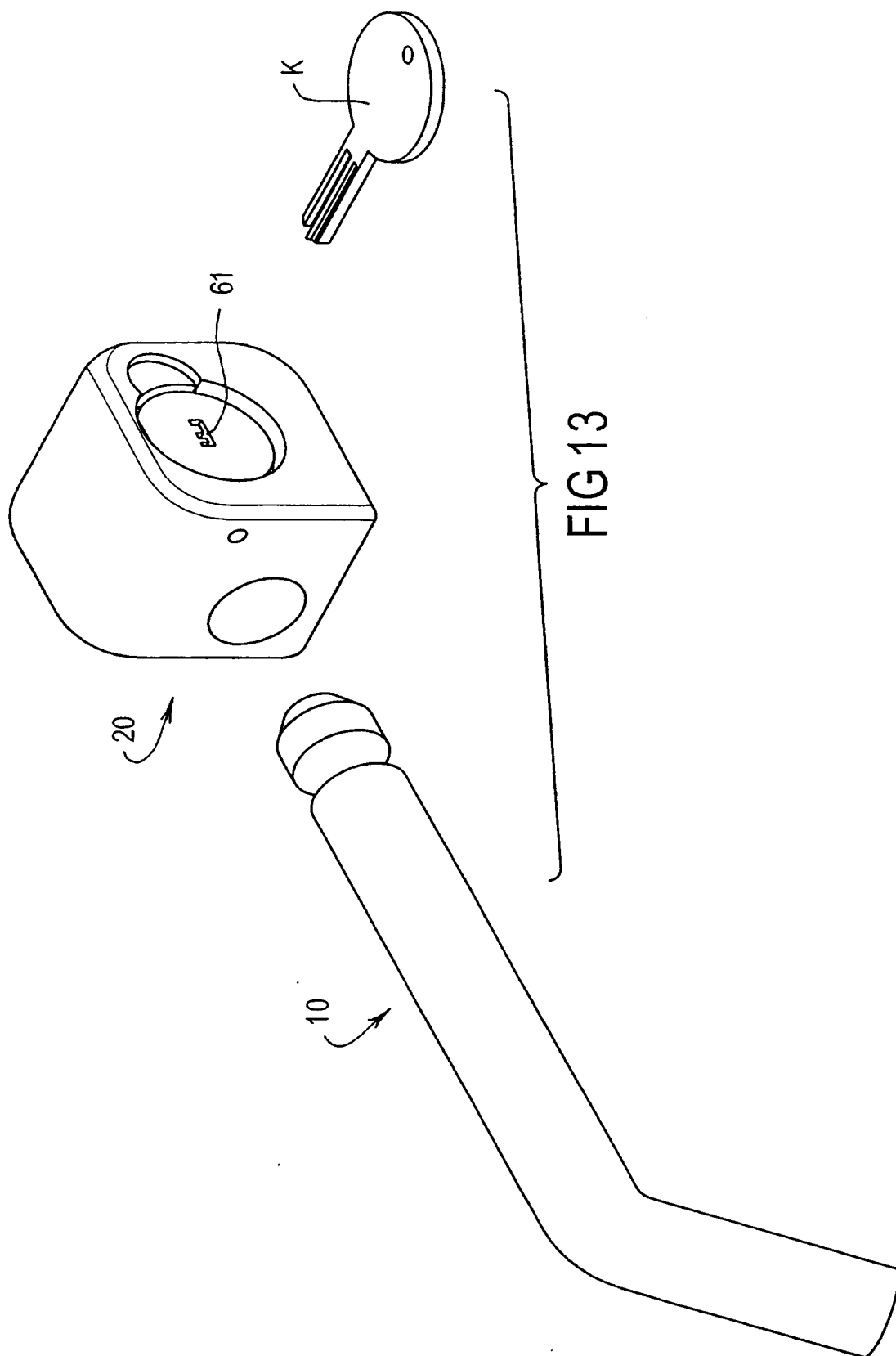
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## INTERNATIONAL SEARCH REPORT

International application No.  
**PCT/AU00/00310****A. CLASSIFICATION OF SUBJECT MATTER**Int. Cl. <sup>7</sup>: F16B 21/18; E05B 65/00, 73/00; B60D 1/58; E04G 25/06

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

IPC: F16B 21/18; E05B 65/00, 73/00; B60D 1/00, 1/58; E04G 25/06

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

AU: IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)  
DWPI with keywords**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	AU 59297/86 (561885) B (WINNER, Jr) 21 May 1987	
Y	Figures 1-5, item nos. 12, 14	1-16, 20-27
	Figures 1-5, item nos. 12, 14	17-19
Y	AU 11548/83 A (McGRATH) 25 August 1983	
	Whole document	17
Y	AU 35197/93 (641351) B (HAYMAN REESE PTY LTD) 16 September 1993	
	Whole document (especially item 22)	18-19

☒ Further documents are listed in the continuation of Box C ☒ See patent family annex

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"A" document defining the general state of the art which is not considered to be of particular relevance	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"E" earlier application or patent but published on or after the international filing date	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search <b>3 May 2000</b>	Date of mailing of the international search report <b>12 MAY 2000</b>
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustalia.gov.au Facsimile No. (02) 6285 3929	Authorized officer  <b>JEFFREY CARL</b> Telephone No : (02) 6283 2543

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU00/00310

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	AU 48588/79 (535248) B (RITCHIE) 7 February 1980 Whole document	1-7, 11, 14-16, 20-24
X	AU 72480/94 A (COMBUSTION ENGINEERING, INC.) 20 February 1995 Whole document	1, 2, 20, 23, 24



International application No.  
**PCT/AU00/00310**

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